Population and Community Ecology of Crayfish in an Urban Brook : Tibbetts Brook in Van Cortlandt Park

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Abstract: Urban freshwater biodiversity represents one of the most imperiled biological communities on the planet (Dudgeon et al 2016). Additionally, the structure of biological communities and their functional roles in cities has been barely explored (McIntyre 2000). Invertebrates constitute the majority of metazoan biomass in freshwater ecosystems with many species such as fresh water crustaceans performing multiple positive ecological services. However for large bodied crustaceans such as crayfish, NYC has little to no information available on community composition, biogeography and functional capacity. In addition, 40% of crayfish species in North America are threatened by human activity, and the majority of species lack geographic range maps (Lieb 2011). The aim of our study is to initiate the first Crayfish study within Tibbetts Brook to expand our general knowledge of urban crayfish ecology and cycle back our findings to park management and the future daylighting of Tibbetts Brook.

Research Questions

We asked a comprehensive set of initial questions regarding the community and population structure of crayfish in Tibbetts Brook.

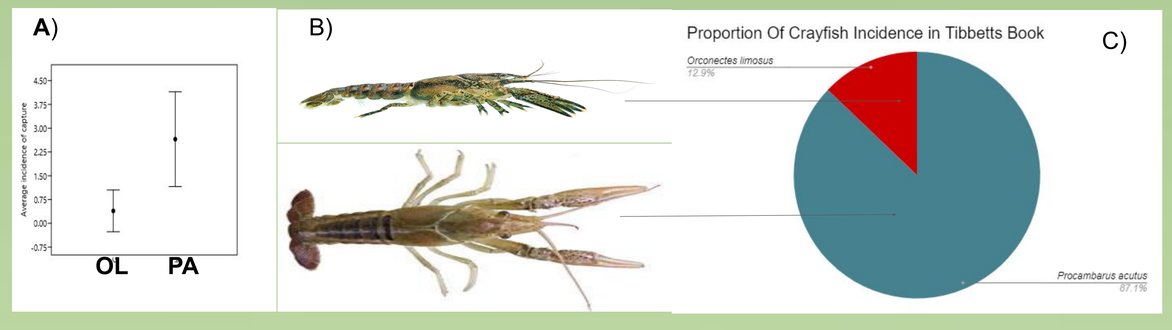
1. How many species of crayfish exist within Tibbetts Brook?
2. Are crayfish species evenly distributed in their abundance or do some species exhibit dominance?
3. Are non-native and invasive species of crayfish present in TB?
4. Does temperature and dissolved oxygen (water quality variables) predict crayfish incidence?
5. Does brook geometry predict crayfish incidence?
6. Do crayfish demonstrate competitive exclusion and niche differentiation?

Figure 1: Showing water quality parameters within TB at Site 1= Bronx/Yonkers Border and Site 2= Where the brook enters into the lake. (From Abbatangelo et al 2016 unpublished data).

Methods

Our site in Tibbetts Brook consisted of a 400 meter transect, where we placed a total of 9 traps and placed one every 40 meters. The minnow traps had Purina dog food placed inside every Monday, and we routinely checked it the next day. All traps were marked on a GPS, and each crayfish was weighed on a small weighing scale. We measured bank width/depth with a tape measure and meter stick, and we used a YSI water quality probe to measure O2 levels, temperature, and conductivity. We entered our data into Excel, where we then analyzed the information through T-test a linear regression.

Figure 4. Map of Van Cortlandt Park and Our study site Tibbetts Brook



Questions 1, 2, 3

Figure 2: ***A)*** *Box plot showing the differences in average incidence of Orconets limosus and Procambarus acutus. T-test results: p-value (<.05)*.* ***B)*** *Pictures of both species observed within this study* ***C)*** Across our sampling location (n=9) we detected two species of crayfish. *Procambarus acutus* and *Orconectes limosus*. *P. acutus* incidence accounted for 87.1% of capture and *O. limosus* 12.9%.

Question 5&6

A) Brook Geometry (Water Depth x Bank Width) vs. species specific incidence

B) **Avg. Crayfish Incidence per Site**

C) All Crayfish Incidence vs. Brook Geometry (Water Depth x Bank width)

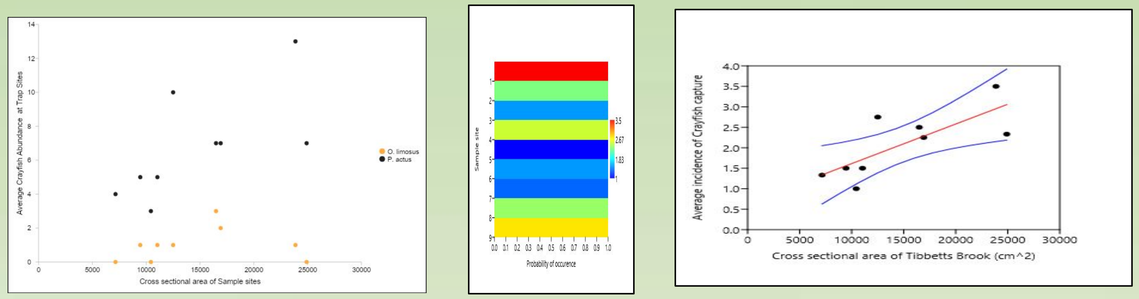


Figure 3.
A) *Linear model demonstrating the differences in habitat used by P. acutus (Black) and O. limosus (orange) according to the cross sectional area (cm) of Tibbetts Brook. P. acutus abundance appears to be significantly more bounded to the geometry of the brook then O. limosus suggesting different use of microhabitat.*
B) *Matrix plot across the whole sample space demonstrating clear heterogeneity of crayfish abundance within Tibbets Brook. Each colored rectangle represents a sampling station and the color representative of the density of crayfish (Red to Blue).*
C) *Linear plot of the cross sectional area of the brook and the average incidence of all crayfish species. Blue lines equal 95% confidence intervals (p. value = <.05)*

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Results/Analysis

Our study detected two species of crayfish living and breeding within TB (**Procambarus *acutus*** and **Orconectes *limosus***) through replicated trapping and observational effort. We found P.*acutus* to account for 87% of the capture.

P. *acutus* is considered non-indigenous to the Hudson Basin and therefore, the crayfish community of Tibbetts Brook is experiencing a recent transition in structure.

Our findings show that geometry is the most important component of our analysis, with the cross sectional area driven by bank width, providing significant predictive power over crayfish incidence within our sample.

Temperature and Dissolved oxygen showed little predictive power over the short duration of our study.

Crayfish species appear to use different microhabitats and demonstrate different dominance behaviors as well as possibly different breeding time periods.

Observations from the Field

-*P. acutus* is significantly larger in mass in comparison to O. *limosus*.
-*O. limosus* early instars were observed compared to no *P. actus* instars suggests different breeding times.
-*P. acutus* was typically the first species to arrive at traps and demonstrated dominance behaviors such as physical movements and displays. *O. limosus* is likely behaviorally subdominant to *P. acutus.*

Major Conclusions

- **Tibbetts Brook sustains a large breeding population of two species of crayfish which appear to have different niches**
- **The potential Daylighting of TB should account for the geometry of the engineered brook and its relationship to biodiversity**

Citations

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